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Abstract

Twc problem-solving IBM 1130 computers were installed in twc New Orleans high schcols fcr a project designed tc enrich the mathematics, science, and physics curricula, tc provide student mctivation through individualized instruction, to develop course materials, to develop programing skills, and to encourage brcader computer use in schools. Four key teachers from each school (who participated in an inservice training prcgram in which they learned the FCRTRAN computer language, had "hands on" experience with ccmputers, and developed programs and materials tc incorpcrate problem solving in their curricula). consultants from IBM, vclunteer research engineers and computer analysts, and a computer center assistant staffed the prcject. Students were chosen for the project on the basis cf aptitude and achievement; they received instruction in computer use as part of the regular curriculum. In additicn to teaching activities, the project utilized ccnferences, meetings, and instructional courses for teachers and administratcrs to extend prcblem solving techniques to a wider variety of students and curricular areas. A project evaluaticn showed the project as successful. (SP)

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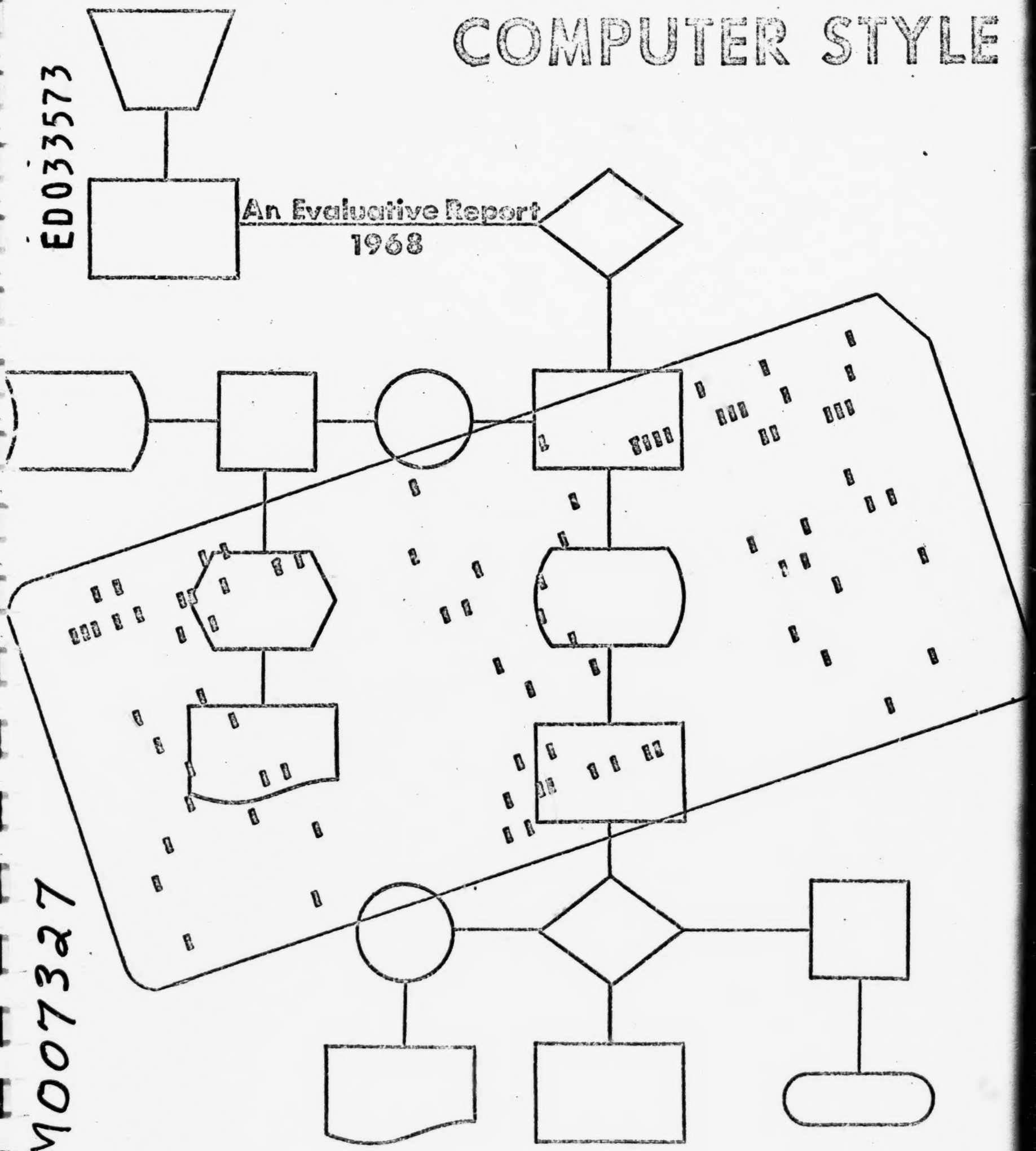
PROBLEM SOLVING— COMPUTER STYLE

An Evaluative Report
1968



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NEW ORLEANS PUBLIC SCHOOLS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Evaluation Report

of

PROBLEM SOLVING-COMPUTER STYLE

Funded by

Grant OEG 3-7-703834-4813

Under Title III

of the

Elementary and Secondary Education Act

of 1965

August 31, 1968

NEW ORLEANS PUBLIC SCHOOLS

Carl J. Dolce, Superintendent

703 Carondelet Street

New Orleans, Louisiana 70130

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FOREWORD

Problem Solving-Computer Style, (Project No. 67-038340), designed to serve public and nonpublic schools in the Parish (County) of Orleans, which is coterminous with the city of New Orleans, was funded by grant OEG 3-7-703834-4813 for $81,299.

As a result, during the year 1967-68, New Orleans Public Schools became the first agency in the city of New Orleans to initiate a program involving the establishment of two computer centers with IBM 1130 installations in two senior high schools, the primary purpose being to add a new dimension to pupil experiences in mathematics and science teaching through use of the computer as a problem solving tool.

The project assumed shape and form under the aegis of Dr. Malcolm F. Rosenberg, Jr., Assistant Superintendent in Charge of Instruction.

A complete program evaluation was prepared in August 1968 by Mrs. Angeline L. Werner, Supervisor of Mathematics for the school system as well as coordinator of the computer project, and submitted to appropriate administrators. The following report, published through the Office of Special Projects, contains essentially the same information with the general exception that discussions of limited local interest have been condensed or eliminated.

Contributors to this report as well as to the project's success are the seven key teachers who integrated computer activities into their regular courses. They are:

Martin Behrman Senior High School	John F. Kennedy Senior High School
Mr. Michael A. Achary (Mathematics)	Mr. Raymond P. Cougle (Chemistry)
Mr. Harold J. Contreary (Mathematics)	Miss Jean I. Cullen (Mathematics)
Mr. Milton Roos (Physics)	Mr. Edmond C. Drouet (Physics)
	Mrs. Solange G. Petersen (Mathematics

PLANNING

Early in the 1966-67 school year, Mrs. Angeline L. Werner, Supervisor of Mathematics (K-12), and Miss Adrienne Rung, Supervisor of Science (K-12), were informed by Dr. Malcolm F. Rosenberg, Jr., Assistant Superintendent in Charge of Instruction, New Orleans Public Schools, that a proposal for a Title III project, providing possibilities for expansion of the existing mathematics and science programs through installation of two computer centers in two senior high schools, the computers to be used as a problem solving tool, was being considered.

Several conferences followed involving the Assistant Superintendent, the supervisors, Mr. Denis E. Vanek, IBM representative, and the program writer, for the purpose of discussing the various aspects of the proposed project.

At one of these meetings, the supervisors were asked to make recommendations as to which two senior high schools would be the most logical ones in which to initiate the program. Martin Behrman Senior High School, 715 Opelousas Street on the west bank, and John F. Kennedy Senior High School, 5700 Wisner Boulevard, on the east bank of the Mississippi River were recommended, the thinking of the supervisors being that both schools had similar mathematics and science programs, both had teachers who had some previous exposure to computer science and, as the schools were on opposite sides of the Mississippi River, the computer centers might eventually serve more children in the Parish of Orleans.

Mr. Vincent A. Palisi, Principal of Behrman, and Mr. Alfred L. Firment, Principal of Kennedy, were approached by the supervisors. Both principals were receptive to having their schools participate in the program. Locations for the computer centers were determined and remodeling plans outlined. Four experienced certified teachers in each school were approached. The eight teachers made a tentative commitment to serve as center teachers pending the approval of the project.

Late in October of 1966 the supervisors met with the principals and teachers for a general discussion of objectives, in-service, program development, financial aspects, program implementation, off-period relief (one period), mechanics of scheduling, and evaluation.

On November 7, 1966, seven of the teachers (one had withdrawn from the program for personal reasons), the principals, the supervisors and Dr. Rosenberg met with Mr. Vanek. At this meeting, Mr. Vanek explained the adaptability of the 1130 system to small-scale scientific applications and outlined three stages of in-service training for the teachers.

At the end of the school year, the supervisors were approached as to which one would assume the responsibility for coordinating the program. Mrs. Werner accepted the assignment and on June 2, 1967, she was designated Staff Coordinator.

FACILITIES AND EQUIPMENT

As the original contract with the IBM Corporation called for rental of the 1130 system to become effective on July 6, 1967, the staff coordinator and the science supervisor turned their attention to the preparation of the facilities. Early in June, 1967, it was discovered that the budget provision in the proposal for remodeling both schools to house the computers was inadequate. The assistance of the Superintendent was sought in solving this problem, and remodeling got underway.

By late October the installation of an IBM 1130 system, consisting of four pieces of equipment--IBM 1130 processing unit, 1132 printer, 1442 card reader, and 029 card punch--in each of the schools was completed.

In addition, each center was equipped with a teacher's desk, a file cabinet, a card file, and three chairs.

CONSULTANT SERVICES

Although the project called for the formulation of exact evaluative methods by center teachers and consultant from education and industry during the summer of 1967, the teachers felt that they needed the summer to develop their own programming techniques and skills. After trial and error procedures and consultation among themselves, assistance was solicited from IBM personnel. This type of experience proved valuable, however, as it gave the teachers some insight into the difficulties that might be experienced by students.

The staff coordinator made personal visits to staff members of Louisiana State University in New Orleans and Baton Rouge for the purpose of discussing evaluation. The concensus of feeling was that the best evaluation at the present time would be in terms of subjective evaluation and observance of what the pupils could do by way of writing operational and functional programs.

Invaluable assistance for which all persons involved in the program are deeply grateful and appreciative was received from a core of research engineers and computer analysts of The Boeing Company. This service, no cost involved, was initiated by Mr. J. A. Lash and Mr. F. W. Hoffman, who secured the company's approval (not sponsorship) for this core of volunteers to work with teachers and students. Their services included the construction of a testing instrument, consultations with the key teachers, and direct pupil instruction. For a comprehensive report on their activities, conclusions and recommendations see Appendix A.

COMPUTER CENTER ASSISTANTS

Although the project provided for two computer center assistants only one, Mr. Charles R. Wick, could be found. Several other applicants were interviewed; some did not interview to satisfaction and some declined to accept the position when informed that the duration of the position depended on the refunding of the project.

Mr. Wick served both centers; Mondays, Wednesdays, and every other Friday at Behrman, and Tuesdays, Thursdays, and every other Friday at Kennedy. His duties included supervising the computer room operations, coordinating and maintaining computer and keypunch scheduling, providing operational orientation and assistance to teachers and students, notifying the IBM Corporation of machine malfunction, answering the telephone, keeping records and statistics on computer room use and student programs, checking on computer room supplies, and making brief monthly reports in writing to the staff coordinator. On days when Mr. Wick was not present, the key teachers and responsible students performed these tasks, remaining if necessary until 5:00 p.m.

could find time after school and on Saturdays to use it, the reason being that IBM had other customer commitments. On several occasions the computer had been moved to a convention or demonstration site.

Thus the third stage of the training program was begun with the teachers having had little hands-on experience with the computer. They developed their programming skills by first programming problems selected from various sources. One very valuable source of problems and ideas was the program written as part of a FORTRAN-QUIKTRAN workshop held by the IBM Corporation for the Philadelphia Board of Education during August, 1966, in which 23 teachers from 2 junior high schools and 5 senior high schools participated. As problems selected from these sources were coded for the IBM 1620 they had to be recoded for the IBM 1130.

Problems were selected from mathematics, physics, and chemistry textbooks in use in the New Orleans Public Schools, and from other supplementary textual material used to enrich the regular program. Approximately 100 operational programs from which the teachers could select materials for classroom instruction, homework assignments, and demonstration were completed.

Toward the end of the eight-week period, the teachers exchanged ideas on approaches to the implementation of the program into their classes. Since the number of pupils who would be involved, the scheduling of classes and teachers, the amount of extracurricular duties to which the teachers might be assigned could not be settled until after the opening of the schools, they decided that teaching by notes would be the best classroom approach. Each would develop

his own lesson plans geared to the learning capabilities of his students. The time allotment for instruction in FORTRAN programming had to be sufficiently flexible so that the regular course work could be completed. As this was to be their first experience with computer oriented instruction, they did not attempt to predict the depth and degree of complexity they could inject into their teaching.

IMPLEMENTATION

As soon as schedules for 1967-68 were settled, each school identified students who would be directly involved in the program by reason of their elections in one or more courses in Advanced Mathematics, Chemistry II, Chem Study, and PSSC Physics. Sixty-one (61) such students were identified at Kennedy and thirty-one (31) at Behrman. Investigation of counselors' records revealed that the I.Q.'s of the Kennedy students ranged from 99 to 135 and the I.Q.'s of the Behrman students ranged from 106 to 137; achievement in the areas of science and mathematics was average or above average. The IBM Programmer Aptitude Test was administered. Only one student from the entire group scored below C, the cut-off point suggested in the test manual.

Instruction in FORTRAN and computer programming was begun prior to the installation of the computers. This instruction was given at convenient intervals in regular class periods. As all students were expected to complete the regular program in mathematics, science, and other subjects, this procedure compounded the students' study time. Students could seek consultation from their instructors before and after school hours and during their free time.

About the middle of the year students in other classes requested some instruction in FORTRAN and computer programming. Two classes of approximately 20 students each were organized at Behrman, each class meeting once a week from 3:15 - 5:00 p.m. on a voluntary basis.

Students from other secondary schools, both public and nonpublic, visited the centers to run programs they had prepared, or to witness demonstrations accompanied by simple lectures conducted by the teachers, the computer center assistant, or knowledgeable students.

INSTRUCTIONAL MATERIALS

Materials in the Hands of Students

1130 FORTRAN Reference Manual, No. C26-3715-0

Teachers' notes taken during their programmed instruction period of training and from resource and reference materials obtained from ESEA Title II funds, the IBM Corporation, the supervisor of mathematics, and publishing companies

Textbooks (from which most of the problems for programming were selected)

Allendoerfer, C.B. and Oakley, C.O. Principles of Mathematics. second edition. New York: McGraw-Hill Book Company, 1963.

CHEMS Chemistry, An Experimental Science. San Francisco: W.H. Freeman and Company, 1963.

Dolciani, M.P. et al. Modern Algebra and Trigonometry. Boston: Houghton Mifflin Company, 1963.

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Adler, I. Thinking Machines. New York: John Day Company, 1961.

Andree, R.V. Computer Programming and Related Mathematics. New York: John Wiley and Sons, Inc., 1967.

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Crowder, N.A. The Arithmetic of Computers. New York: Doubleday and Company, Inc., 1960.

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Dorn, W.S. and Greenberg, H.J. Mathematics and Computing. New York: John Wiley and Sons, Inc., 1967.

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Gruenberger, F. and Jaffray, G. Problems for Computer Solution. New York: John Wiley and Sons, Inc., 1963.

IBM DPD Education Development, Education Center. FORTRAN for the IBM 1130. Endicott, New York: 1965.

Jacobowitz, H. Computer Arithmetic. New York: Hayden Book Company, 1964.

Kovach, L.D. Computer Oriented Mathematics. San Francisco: Holden-Day Inc., 1964.

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McCalla, T.R. Introduction to Numerical Methods and Fortran Programming. New York: John Wiley and Sons, Inc., 1967.

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-----, A Guide to Fortran IV Programming. New York: John Wiley and Sons, Inc., 1965.

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Mullish, H. Modern Programming: FORTRAN IV. Reading, Massachusetts: Blaisdel Publishing Company, Inc., 1968.

Murphy, J.S. Basics of Digital Computers. New York: Hayden Book Company, 1958.

National Council of Teachers of Mathematics. Computer Facilities for Mathematics Instruction. Washington D.C.: The Council, 1967.

-----, Computer Oriented Mathematics: An Introduction for Teachers. Washington, D.C.: The Council, 1963.

-----, Introduction to An Algorithmic Language (Basic). Washington, D.C.: The Council, 1968. On order

National Science Teachers Association. Computers-Theory and Uses. Washington, D.C., 1964.

Organick, E.I. A Fortran IV Primer. Reading, Massachusetts: Addison Wesley Publishing Company, Inc., 1966.

School Mathematics Study Group. Algorithmic Computation and Mathematics, Revised Edition. Pasadena, California: A.C. Vroman, Inc., 1966.

-----, Algorithms, Computation and Mathematics (Fortran Supplement). Pasadena, California: A.C. Vroman, Inc., 1966.

Siegel P. Understanding Digital Computers. New York: John Wiley and Sons, Inc., 1961.

Stibitz, G.R. and Larrivee, J.A. Mathematics and Computers. New York: McGraw-Hill Book Company, 1957.

von Neumann, J. The Computer and the Brain. New Haven: Yale University Press, 1958.

Young, F. Digital Computers and Related Mathematics. Boston: Ginn and Company., 1961.

OBJECTIVES

A. The major objectives of the proposed project, Problem-Solving Computer Style, were:

1. To enrich the existing programs in mathematics, chemistry, and physics through the use of a school computer center

2. To have students develop recognition of, and deeper insight into, concepts of mathematics and logic

3. To motivate students through more individulized, challenging instruction

4. To give needed emphasis to the preparation of teacher's guides and textbook supplements by developing material that would be beneficial to similar programs throughout the nation

5. To have students develop an appreciation of the role of computers in pure and applied mathematics

6. To establish long-and short-range goals that could be incorporated into the existing math and science curricula

7. To have students develop some skill in programming fundamentals

8. To encourage students to apply computer concepts creatively to other areas of the instructional program

9. To investigate improvements in the exemplary project itself

B. Activities and procedures used to achieve these objectives were:

Objective 1.

a. Inclusion of some computer concepts and terminology, basic FORTRAN computer language, and programming techniques in the instructional program of students in Advanced Mathematics, Chem II, Chem Study, and PSSC Physic classes at Behrman and Kennedy Senior High Schools

b. Organization of two after-school classes, each meeting once a week, for students from classes other than those mentioned above (by request of these students)

c. Seminars on a voluntary basis for key teachers and students conducted by volunteer personnel from The Boeing Company

d. Visits by students in the program to The Boeing Company and LSUNO computer centers

e. Demonstrations and lectures for students from other public and nonpublic secondary schools at the computer centers by teachers and knowledgeable students

f. Provision of opportunities to nonpublic school students to use the computer centers for testing and debugging programs written under the supervision of their own instructors

g. Plans for a summer program (1968) for students from public and nonpublic schools who have successfully completed Algebra II

Objective 2

a. Review of mathematical concepts and problem solving techniques taught at the 9-11 grade levels immediately followed by computerized problem-solving techniques

b. Instruction in the mathematics involved in new topics immediately followed when feasible by computerized problem solving techniques

Objective 3

a. Individual and small group assistance rendered by teacher before and after school, and during lunch and off periods.

b. Encouragement of students to seek solutions to their individual problems and difficulties before seeking assistance

c. Encouragement of students to seek aid from and to give aid to each other

d. Encouragement of students to search for problems of their own choosing and interest

Objective 4

a. Selecting and refining of programs developed by teachers in the summer of 1967 for instructional purposes, homework assignments, etc.

b. Conferences among the teachers for the purpose of comparing and modifying their methods of approach to programming instruction

c. Reorganization of teaching guides and lesson plans for try-out in the 1968 Summer Program

Objective 5

a. Inclusion of problems requiring tedious computation by ordinary methods for the purpose of demonstrating the speed and accuracy of computer solution

b. Reference reading on the capabilities and limitations of various computer systems

Objective 6

a. Efforts to stimulate teachers' interest in computers and their uses, and the possibility of incorporating computer oriented topics into regular courses

b. Plans to gradually introduce instruction to students at levels below the twelfth grade in the center schools

c. Plans to include computer oriented instruction and programming in other secondary schools

Objective 7

a. Stress on the need for a computer language, careful definition and analysis of a problem, flow charting, testing, and debugging

b. Assignment of homework problems to be solved by usual mathematical and/or computer methods

c. Instruction proceeding from the writing of simple programs for all students to writing complex programs for the more capable students

Objective 8

a. Encouragement of students to find original problems related to other courses they were taking or problems associated with their special interests

b. Encouragement of students to investigate problems submitted by personnel in other subject matter areas as to the possibility and feasibility of programming the problems

c. Encouragement of students to investigate the possibility of writing programs as a service to the administrative staff of the school

Objective 9

See Strengths, Weakness, and Recommendations

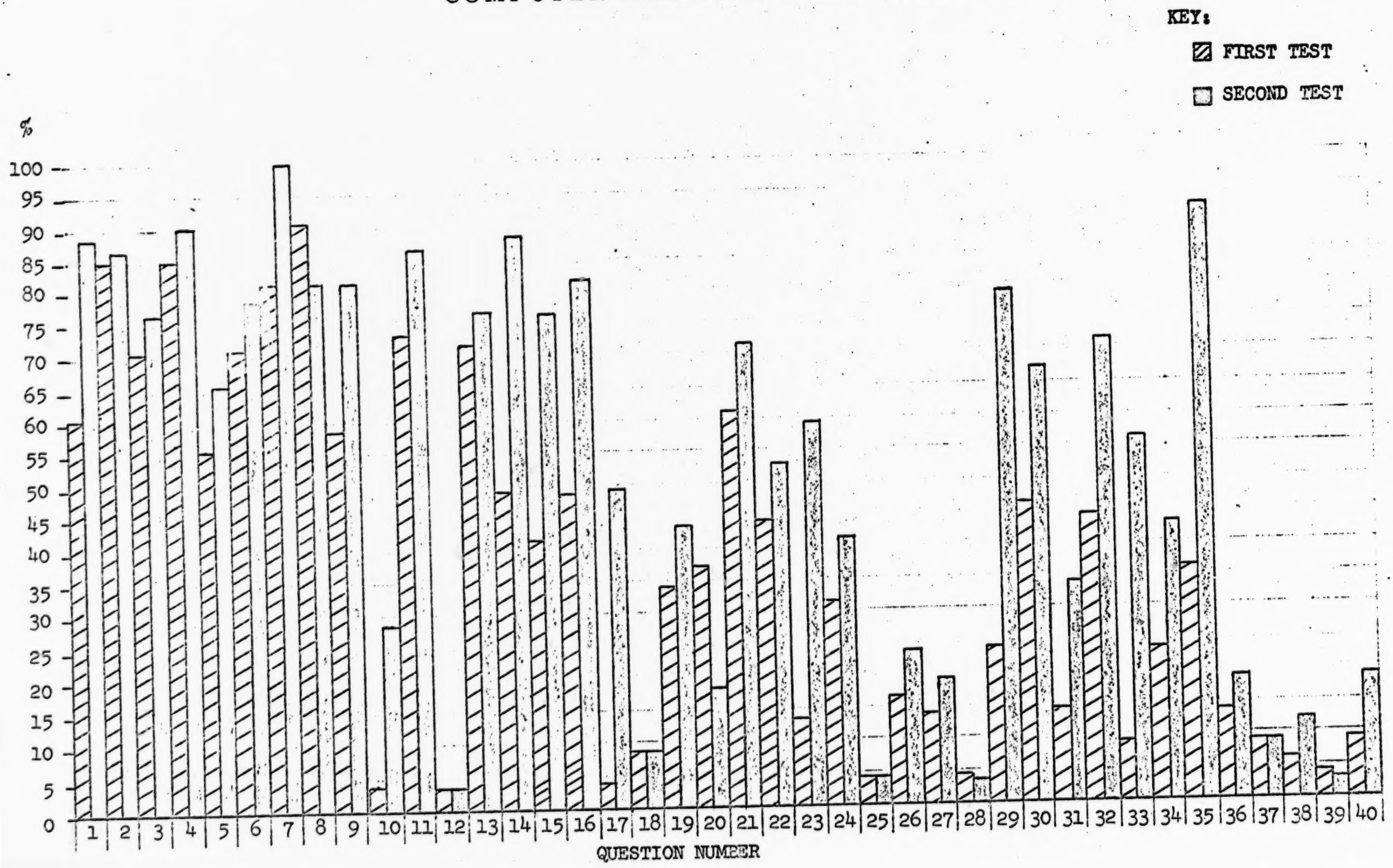
METHODS OF EVALUATION

1. Tests

In addition to the IBM Programmer Aptitude Test, in which all but one student scored favorably, a test entitled "Computer Principles Examination" (See Appendix B) was administered on two different occasions. The first testing was done in December, approximately one month after programming instruction was begun; the second testing was done in early April---just about four months later. It was felt that these were the best times to administer the tests as it measured the achievement of the students after a short period of basic instruction and their progress over a longer period of time.

The test consisted of forty multiple choice questions formulated by Mr. Lash and Mr. Hoffman, research engineers of The Boeing Company. The students were to "choose the most correct answer" from four possible answers. The key teachers did not participate in the planning of the test, nor were they given test results until the second test had been scored. All 92 students took the test both times. A comparison of the results of the tests, showing the percentage of students who made correct responses for each item, is pictured in the following graph.

COMPUTER PRINCIPLES EXAMINATION



As can be observed from the graph some questions were answered correctly by a consistently low percentage of the students. The consensus of opinion among the teachers was that some questions were based on content too far removed from the objectives of the course at the present time.

After reviewing the questions in the light of content covered prior to the taking of the first test the teachers made these observations:

a. Possibly most progress was made during the first month of computer programming instruction; high school students can learn basic FORTRAN with little difficulty. (As a result some of the teachers have expressed the desire to work with students other than the college capable and with students at lower grade levels.)

b. That progress was made over the second time period was implied by a rise of 5 in the average score, and a rise of 13 in the number of items attempted. Also 95% of the students achieved a higher raw score on the second test as compared to the first.

The evaluation of the tests and the test results points out that much more work needs to be done to establish a file of suitable questions for evaluation purposes. It is anticipated that under the leadership of a full-time coordinator, the authors of the test, and consultants from one or more local universities, that this question file will increase considerably. Two different tests of approximately the same level of difficulty might be constructed, one to be used for pre-testing and the other for post-testing purposes.

2. Rating of Student Written Programs

As mentioned early in this report the consensus of advice from staff members of two universities was that the best way to evaluate the project was in terms of "what the students can do." This message was relayed to the teachers. The following is a quote from their final report:

> As with many situations, the best judge of success or failure is the final product. The evaluation of these programs proved to be most difficult, for the types and levels of complexity were almost endless. It was decided to rate the programs by numbers from 1 to 5, the lowest to the highest respectively. A description of each rating follows:
>
> 1. This category included all programs involving simple arithmetic. No extraordinary thought processes were required.
>
> 2. This rating was given to those programs that employed a simple DO-loop, decision making through the use of an IF statement or complex arithmetic.
>
> 3. A program was rated a three if it employed a combination of IF statements and DO-loops. It is important to note that this was the highest level of complexity the students were expected to achieve.
>
> 4. This rating included those programs which employed nested DO-loops. The programs were characterized by complex logic situations and indicated good reasoning ability. "Difficult" would suffice as a one word description of this category.
>
> 5. This rating was given to those programs which used subroutines, nested DO-loops, complex logical decisions, and computed

GO TO statements. Programs written in either MACHINE language or ASSEMBLY language also were placed in this category.

The following table gives a listing of the number of programs which were submitted in each category.

1	223
2	362
3	255
4	106
5	31
Total	1027

Programs listed under group five and many programs under group four involved independent study by students. For the most part programs of this complexity demanded creative insight far above that which was anticipated. With the objectives in mind and the programs as proof, Problem Solving-Computer Style has been both effective and successful.

3. Computer Room Statistics

The following information was submitted by Mr. Wick.

COMPUTER USE AT BEHRMAN

	1967		TIME IN HOURS		1968				
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1131 Central Processing Unit	* N/A	16.53	15.70	17.77	22.32	23.70	23.29	29.59	33.19
1132 Line Printer	N/A	5.57	13.65	16.88	28.77	13.92	22.05	26.41	29.50
1442 Read/Punch	N/A	20.44	14.72	16.53	28.73	30.14	19.73	26.73	27.96
029 Keypunch (no meter)	N/A	N/A	17	10	10	20	26	20	40
Approximate Number of Hours Room in Use	N/A	N/A	43	31	46	44	47	80	13
Time Lost Due to Malfunction in System	0	0	19	4	16	0	0	2	0

* Not available

COMPUTER USE AT KENNEDY

TIME IN HOURS

	1967				1968				
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1131 Central Processing Unit	* N/A	13.90	14.81	23.59	35.98	43.42	65.21	62.03	76.34
1132 Line Printer	N/A	N/A	23.77	22.50	34.63	39.54	60.68	43.93	58.57
1442 Read/Punch	N/A	N/A	14.14	20.54	30.18	37.80	53.07	44.73	67.23
029 Keypunch (no meter)	N/A	N/A	37	22	35	30	40	50	60
Approximate Number of Hours Room in Use	N/A	33	51	45	95	80	130	150	122
Time Lost Due to Malfunction in System	0	0	0	4	0	0	9	6	0

* Not available

Log Information	Time Breakdown in Hours	
	Behrman	Kennedy
Individual students	276.26	504.91
Individual teachers	68.37	41.16
Group of students	5.26	61.42
Group of teachers	.00	31.50
Administrative, Maintenance, etc.	4.91	8.82
Teacher written programs	65.08	51.98
Student written programs	284.35	581.19
IBM written programs	5.61	15.14
Algebra programs	2.33	47.59
Trigonometry programs	327.13	427.82
Geometry programs	2.75	10.07
Advanced Math programs	9.17	66.36
Physics programs	.75	40.97
Chemistry programs	.75	3.49
Social Science programs	3.75	
Programs for project evaluation	9.33	49.78
Formal instruction	208.89	257.82
Extra curricular activities	127.31	322.70
Demonstrations	19.01	47.84
Other public schools	.00	11.26
Nonpublic schools	.00	14.48
Project school	355.23	621.39
IBM staff	.00	.50

Visits from Nonpublic Schools

School	Center	No. of Visits	Purpose	No. of Visitors
Our Lady of Holy Cross College	B*	1	D/L	9
Domminican High School	K	1	D/L	45
Holy Cross High School	K	1	D/L	20
St. Aloysius High School	K	11	RP	27

The St. Aloysius group used the center to run and debug 250 programs.

*Key:

B - Behrman
K - Kennedy
D/L - Demonstration and lecture
RP - Running and debugging programs

Visitation by New Orleans Public Schools

School	Center	No. of Visits	Purpose	No. of Visi
Franklin Sr. (Mu Alpha Theta)	K*	1	D/L	17
Franklin Sr. (Chemistry students)	K	1	D/L	11
Karr Jr. (3 groups)	B	3	D/L	67
McMain Jr.	B	1	D/L	60
Green Jr. (2 groups)	B	2	D/L	72
Woodson Jr. (2 groups)	K	2	D/L	46
Abramson Sr. (Mu Alpha Theta)	K	1	D/L	25
Peters Jr.	B	1	D/L	15
Warren Easton Sr.	K	1	D/L	20

Visitation by Out-of-Parish Schools

School	Center	No. of Visits	Purpose	No. of Visit
Chalmette High (Mu Alpha Theta)	K	1	D/L	20
West Jefferson High	B	2	D/L	22

In addition visits were made by Dr. Rosenberg and many other interested local school personnel, the supervisors of mathematics and science from the State Department of Education, local business executives, parents, and interested out-of-town educators from Washington, D.C., Kansas, Canada, France, and India.

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*Key:

B - Behrman
K - Kennedy
D/L - Demonstration and lecture
RP - Running and debugging programs

EXTENSION OF TEACHER AND PUPIL INVOLVEMENT

One of the long-range goals of the program (See Objective 6)---extension of computer problem-solving techniques to a greater number of secondary students in mathematics, science, and other subject matter areas--necessitates extension of teacher involvement. Efforts in this direction include:

1. Pre-School Conference, August 21-25, 1967

The program for secondary teachers of mathematics, approximately 250 in number, included four general sessions, one hour each, on the subject of computers. Dr. James R. Oliver, Dean of the Graduate School and Director of the Computer Center, University of Southwestern Louisiana, and Mr. Edward A. Moellering, Mathematics Analyst Senior, Space Division, Chrysler Corporation, addressed the group for three of these sessions. In the fourth session, one teacher from each of the project schools addressed the group on "Problem Solving-Computer Style."

2. Meetings of Heads and Chairmen of Mathematics Departments

At these meetings involving representation from 36 New Orleans Public Junior and Senior High Schools, the staff coordinator encouraged field trips to the computer centers for demonstration and lectures. The possibilities of eventually introducing computer concepts, mathematics, and languages to all secondary schools were

discussed. The availability of NSF Sponsored Institutes and sources of reading material on computers and how some schools had implemented some degree of computer oriented instruction into their regular teaching were made known. Each school representative was given a copy of the NCTM pamphlet "Computer Facilities for Mathematics Instruction." One such meeting was held in the Kennedy center so that the heads and chairmen could be given a demonstration and lecture by two Kennedy students.

3. IBM Sponsored Programmed Instruction Courses

Heads and chairmen were requested to sound out teachers in all areas of the curriculum as to whether they would be interested in some form of in-service training in computer orientation. Response far exceeded expectations and as a result a general meeting was planned. The Archdiocesan Schools were notified of the meeting by a letter to Mr. Richard T. Corrado, Assistant Superintendent of the Archdiocesan Schools. Mr. Vanek, IBM representative, discussed two programmed instruction courses, "FORTRAN for the IBM 1130" and "Basic Computer Concepts."

Registration forms, calling for the name of the interested teacher, the name of the school represented, subject(s) taught, previous experience or courses taken, and the programmed instruction course elected were distributed.

Examination of registration forms revealed the following information.

	A	B	C	D	E	F
New Orleans Public Senior High Schools	6	38	29	9	29	9
New Orleans Public Junior High Schools	11	37	29	8	30	7
Archdiocesan Schools	5	11	7	4	6	5
	22	86	65	21	65	21

KEY: A....Number of schools represented

B....Number of teachers

C....Number of teachers with no previous training or experience

D....Number of teachers with previous training or experience

E....Number of elections in FORTRAN

F....Number of elections in Basic Computer Concepts

Subject matter areas in which the teachers taught were mathematics, general science, biology, social studies, English, French, business education, industrial arts, and art.

In addition, the mathematics consultant, who had previous training in computer science, the supervisor of counseling and a junior high school counselor registered for either or both of the courses.

4. IBM Sponsored Summer Course for Secondary Teachers

The IBM Corporation offered a course, July 1-19, 1968, 7-8 hours per day, free of charge, for secondary teachers in the New Orleans area. The content of the course was described as including topics relative to computer usage in education, curriculum materials on computers and data processing and laboratory experience.

This course was advertised in the Superintendent's Bulletin and in the local newspapers. Applications were received from teachers in both public and nonpublic schools in New Orleans and some were received from adjacent parishes (counties). Applications exceeded expectations. Those received by the staff coordinator were sent to Mr. Vanek who made the final selection of the participants.

It is hoped that survivors of the programmed instruction group and the IBM summer course will supplement the courses they teach and enrich club activities through the introduction of the FORTRAN language and problem solving techniques with hands-on experience at the computer centers.

5. Pilot Classes in Computer Oriented Mathematics

Approval has been granted by the Louisiana State Department of Education to offer an elective course in computer oriented mathematics

on a pilot basis in Behrman, Cohen, Fortier, Kennedy, and B.T. Washington Senior High Schools and in Karr and Priestley Junior High Schools. This course is not to replace any of the mathematics courses in the regular program. Pupils successfully completing the course will receive "one unit of enrichment credit, to be applied over and above the present requirements for graduation." This pilot run is not being financed through "Problem Solving-Computer Style."

6. 1968 Summer Program

A six-week instructional program for 70 students was planned for the summer of 1968. Brochures (See Appendix C) were sent to all New Orleans secondary schools and Mr. Richard T. Corrado, Assistant Superintendent of the Archdiocesan Schools. The program was announced in the Superintendent's Bulletin and in the local newspapers.

The basic requirements for registration were the successful completion of Algebra II and the taking of the IBM Programmer Aptitude Test at the time of registration.

A list of applicants in the order of their scores on the aptitude test was established in each school. As Kennedy received more than its quota of applications and Behrman received less, the Kennedy teachers chose the first 40 applicants for their classes. The remaining applicants were contacted by telephone and given a choice of remaining on Kennedy's waiting list or availing themselves of the vacancies existing at Behrman.

At this writing a complete evaluation of this program is not possible, but school representation in the program is as follows:

Public Schools	No. of Students
Behrman	12
Carver	1
Easton	3
Fortier	2
Franklin	7
Kennedy	19
McDonogh	2
Total	46

Nonpublic Schools	
Cor Jesu	6
De La Salle	2
Dominican	1
Holy Angels	1
Holy Cross	1
Holy Name of Jesus Mercy	1
Newman	1
Sacred Heart of Jesus	3
St. Aloysius	1
St. Augustine	2
St. James Major	3
Ursuline	2
Total	24

According to the last word-of-mouth reports the summer program was well attended. Teachers and students enjoyed freedom from "grades;" students enjoyed freedom from the pressure of "keeping up with other subjects." Many students remained after their 2 hours of instruction and were given even more individual assistance and computer time. All of them wrote some functional programs, the degree of complexity depending upon each individual's rate of progress.

STUDENTS' EVALUATION

In order to obtain an assessment of the computer program as it was implemented this year from the students' point of view, the teachers at Kennedy devised a questionnaire, requesting students to assign ratings to each of the items. This questionnaire was given to the ninety-two pupils directly identified with the program during a regular class period. In addition, students were asked to write a short paragraph on their reactions to the course. In the hope of obtaining unbiased opinions, the students were not required to sign the questionnaire nor the statement. For a copy of the questionnaire and the results of students' ratings of the program see Appendix D . The teachers made a careful study of the ratings and the paragraphs. In their final report, the teachers made these comments on the students' evaluation:

> As in any unsigned questionnaire and statement, we felt that some students answered the way they thought we wanted them to, while others found it easier to put "no opinion" on most of the questions. However, in our judgement the majority of students answered the questionnaire honestly and wrote the paragraph pointing out some of the strengths and weaknesses of the program from their viewpoint.
>
> The paragraphs written by the students reflected their answers to the questionnaire. Nevertheless, we feel it is worth repeating some of the ideas, commendations, or criticism offered by the students, even though some may be repetitious.
>
> Of the 61 students at Kennedy 57 found that having to wait for the keypunch machine was detrimental to the program. In fact, many of them lost their enthusiasm because of this fact. This was not as great a problem at Behrman, since there were only 31 students in the program.

Another major criticism of the program was its implementation into the regular mathematics and science classes. Most of the students expressed concern because the time alloted to computer programming made it difficult to keep up the pace required to complete the regular mathematics and science programs. They were almost unanimous in suggesting that it be a separate course and that it not be mandatory for students electing one or more subjects where the study of FORTRAN would be implemented.

On the positive side, most students felt that the opportunities presented by the computer were unique and this they greatly appreciated. Many felt that their experiences would be valuable in their later studies or activities.

The majority believed that the use of the computer encouraged organization and independent study. Using the computer as a problem solving tool made many of the concepts in mathematics and science more vital and understandable.

There was an increase in the ability to recognize meaningful problems, analyze them, and systematically break them down into logical steps that became a FORTRAN program.

Most students were satisfied with the instruction received and the assistance offered by the teachers in the preparation and finalization of their programs.

The computer acted as a cohesive force among the various classes. The pupils were faced with similar problems which involved similar situations, and they learned to ask for and accept assistance from their peers.

Finally, it seems that the students learned the role the computer plays in the mathematics and science fields. They have removed the computer from the role of the "magic machine" to that of a useful tool in the solution of otherwise difficult and time-consuming problems.

TEACHERS' EVALUATION

The teachers, at a general meeting for the purpose of summarizing their evaluation of the program, compiled the following report.

> Overall, the teachers rate the program as having been quite successful. An examination of the objectives of the program reveals that enrichment of the existing programs in mathematics, chemistry and physics was a primary objective. The students in computer-oriented courses received experiences not otherwise available to them through this extension of the scope of 'normal' mathematics and science programs. This resulted in the generation of greater enthusiasm for these courses and encouraged the pursuit of logical solutions of problems relating to mathematics and science.
>
> The use of the computer in combination with the regular classes has done much to improve the pupils' concepts and relationships in mathematics and science. Students have come to realize the importance of understanding just what a process does, of separating relevant from irrelevant information and facts, of organizing and expressing their relationships mathematically so that a solution can be obtained. In general, we feel the course has done much to give students a greater insight into logical, orderly thinking. Pupils can better associate their understanding of mathematical processes to the solution of problems and thereby recognize and appreciate the role of mathematics and science in the computerized society in which we live.
>
> The computer has served as a motivating device to achieve greater interest in

mathematics and science. Many pupils have been stimulated to develop study habits that will prove useful, particularly in the fields of mathematics and science where independent progress is so essential. Some have developed a curiosity about problems, and the interest and initiative to pursue these problems independently to a successful conclusion. Some have shown a great deal of originality and imagination in developing programs, such as games, which are amusing to run, but very difficult to program.

Teachers are currently assembling material designed to be a comprehensive study guide for use on the secondary level. A compilation of programs is being prepared, and will be available to interested school systems from other areas of the country.

In the computer program concentration has been in the area of applied mathematics rather than pure mathematics, since we feel that pure mathematics is the realm of the theoretician, not the high school student. The program has engendered an appreciation for applied mathematics.

We would hope that the program, which has involved only a minority of students in the two schools, will encompass greater numbers of students as time passes, until eventually all of our mathematics and science students will receive at least an orientation in computer programming. More schools should become involved, with more students being reached and more teachers participating.

All students have developed an appreciation and understanding of the capabilities and limitations of the computer, and have acquired some skill in writing computer programs in FORTRAN language. Original plans were to have students run one or two successful programs by the end of the course. Most students in the program have on file at least nine functional

programs. Some students have as many as fifteen, and one has thirty-six on file and has actually done many more, both in ASSEMBLY and FORTRAN. Student programs are being evaluated in another section of this report.

To encourage students to apply computer concepts to other areas of the instructional program, special demonstration programs have been written. An effort is being made to extend the program to include applications in the fields of biology and business education.

This year has been one of experimentation, based solely on our experience as teachers in our respective fields. We believe it has been a learning experience for us as well as the students. Good experiences will be repeated; mishaps, hopefully, not. We believe that all of us have found it most enjoyable and rewarding.

PRINCIPALS' COMMENTS

Mr. Vincent A. Palisi, Principal

Martin Behrman Senior High School

I believe it safe to say that both teachers and students profited immeasurably from their experiences in the computer program. The three teachers, Mr. Michael Achary, Mr. Harold Contreary, and Mr. Milton Roos, gave unstintingly of their time during, before, and after school to help the students learn the FORTRAN language, to operate the keypunch and the computer itself. Certainly, the number of programs prepared and run by the pupils attests to the interest engendered throughout the year.

Although it would appear that few students (thirty-one) were involved in the primary program, it must be remembered that at the beginning, the teaching was limited to pupils of Chemistry II, PSSC Physics and Advanced Mathematics. Most of the same pupils were registered in at least two of the classes, and some, in three. However, the teachers eventually involved in the program many more pupils from classes in Algebra II, Trigonometry, Chemistry I and in Physics. This was possible because teachers worked with the additional pupils before and after school or during free periods some pupils had.

I believe that during the first year both students and teachers learned not only the limitations of the computer but also its importance in the fields of mathematics and science. Hopefully, in the future, other fields of the curricula will become involved.

Mr. Alfred L. Firment, Principal

John F. Kennedy Senior High School

The installation of a computer center in our school under the supervision of four qualified teachers has generated a great deal of interest among students in our advanced mathematics and science courses who were assigned to this computer center. In view of the many educational applications of the computer, it is urgent that finances be provided to enable us to expand our curricular activities to this vital area.

BRIEF SUMMARY OF OUTCOMES

Many students reached the point at which they could successfully program their homework assignments; some improved on the programs written by the teachers in the summer of 1967; some programmed problems of their own choosing; unfortunately, but understandably, a few did not take to Problem Solving - Computer Style to any appreciable degree.

In addition to achieving skill in programming, some students developed considerable skill in keypunching and computer operation, and acquired technical knowledge as well.

Some students learned to program the IBM 1620.

Some students learned elementary ASSEMBLY and BASIC languages.

Persistence in working a problem to a successful end on their own replaced "working to get the answer in the back of the book."

There was an increase in cooperation among the students themselves, and in willingness to share information.

There was an increase in student participation in classroom discussion.

A few students taught programming to students from other schools to a degree that they, too, were able to write, test, and debug programs.

Two Kennedy students and one Behrman student are definitely known to have obtained summer employment as a result of their ability to program.

There was an increase in the willingness to render services to the school in and after school hours.

While the students in both schools rendered services of a data processing nature within the limitations of their own capabilities and the capabilities of the computer system, one final project, undertaken by a team of three Kennedy students under the supervision and guidance of Mrs. Petersen, is most worthy of mention. This project is entitled "The Passed-Failed Report, Computer Style." This project involved the writing of three programs. The Foreword and a print-out of the first program is included in this report. See Appendix E .

STRENGTHS OF THE PROGRAM

The degree of success attained by the program can be attributed primarily to the seven key teachers who, in addition to their responsibilities of teaching the most advanced mathematics and science programs (other than Advanced Placement) offered in the public secondary schools of the New Orleans system, accepted willingly and unflinchingly the challenge presented by the project. At no time was their interest and enthusiasm dampered by the demands on their time and energy over and above the call of duty.

The cooperation of the key teachers and the principals---they assisted the teachers in every way possible to make this pilot program meaningful and successful---with the staff coordinator was evident at all times.

The choice of the computer center assistant was a very good one. He performed the duties assigned to him promptly and efficiently, got along well with principals, teachers and students, and served overtime when certain occasions arose.

The students in the program were above average. They have a head start if they choose to avail themselves of the opportunity to use computers in their college courses. It is possible that their experience will influence their elections in college courses and in shaping their future careers.

The program is an outstanding example of innovation. It injected new life into the existing curriculum and a new approach to the problem of meeting individual differences in students.

Immediate hands-on experience with the computer stimulated, maintained, and increased pupil interest, persistence, and performance beyond expectations. Immediate access to the computer enabled teachers to supplement their file of programs for demonstration and instructional purposes, and to learn more about the computer system itself.

Since the program was a pilot run, the teachers felt very little restriction on them as to what, when, and how to teach programming; they were free of pressures such as scheduled meetings, progress reports, etc. The freedom to explore and experiment, to exchange ideas on procedures and teaching techniques when occasion demanded stimulated creativeness in the teachers, and they are already thinking in terms of modification and improvement.

The extra preparation period provided in the program gave additional time to the teachers for lesson planning, individual and group conferences and assistance to students, and assistance to each other. They were able to coordinate their plans so as to avoid duplication of teaching and learning for students enrolled in more than one class in which programming was being taught.

The supportive services rendered by the personnel of the IBM Corporation and The Boeing Company in supplying evaluation instruments and resource materials, conducting seminars for students and in-service programs for teachers was greatly appreciated. The supportive services rendered by LSUNO was greatly appreciated. Some Kennedy students received additional instruction, and were encouraged to use the facilities of the university whenever they were available.

Computer room supplies were available at all times, and ample resource and reference materials were supplied by the staff coordinator.

Machine malfunction created no serious problems. The IBM Corporation sent service personnel immediately and usually repairs were completed within two or three hours.

WEAKNESSES OF THE PROGRAM

Although the authors of this evaluation report agree that the first-year pilot run attained a degree of success far greater than was anticipated, they feel that consultants and a pre-assigned full-time coordinator should have participated in the planning of the proposal and should have had the opportunity of reviewing the proposal prior to its being submitted for approval and funding.

The proposal, although calling for extension of the project to include more schools, teachers and students, was predicated on a decreasing budget over a three-year period. The possible need for additional equipment, for remuneration for in-service training and a relief period for additional teachers, for an increase of computer room supplies, and for overtime remuneration for custodians, teachers, and computer center assistants in the event that the centers might be used beyond 5:00 p.m. and on Saturdays, were overlooked.

Teachers felt that their in-service training was inadequate. Some felt the need for more course work in computer science; some felt their progress was delayed during their summer training period because requests for assistance was on a "catch as catch can" basis, and the computer was available only part of the time. Some expressed a need for more information about the computer itself and its uses.

The staff coordinator felt the need for some preliminary training in computer science and in the logistics of a Title III project. Most of her information was obtained from professional reading and limited contact with other school systems with similar programs.

The assignment of the supervisor as staff coordinator was a mistake. The time devoted to the project greatly curtailed her other duties. Some frustration was experienced because she felt that neither job was done to her own complete satisfaction.

As is the case with almost any new program, there were problems in its inception. The first was the delay in the preparation of the facilities and the installation of the equipment. The interruption encountered by the school staff and custodians while remodeling and installation were going on compounded the usual problems that occur in the opening months of a school year.

The program provided for only one keypunch machine in each of the two schools. Early in the year this proved to be inadequate at Kennedy because of the large number of students involved, and at Behrman because a considerable number of the students were bus students and it was difficult to do their keypunching after school hours. The time for each student to use the machine was limited as a result, sometimes to as little as fifteen minutes per day. The students refused the offer to have their programs punched at the data processing centers in Fortier and McDonogh Senior High Schools. They wanted the experience of punching their own programs; they wanted to test them and debug them almost immediately after writing them.

No laboratory periods were provided for computer students. This made it difficult for students with no off periods, using public or school bus transportation, and students holding jobs immediately after school (or any combination of these reasons) to prepare their computer materials.

The selection of the students on the basis of their elections in Advanced Mathematics, Chemistry II, Chem Study, and PSSC Physics posed a problem for some of the students. As there was only one class of each of these subjects in each school (exception, Kennedy had two sections of Advanced Mathematics), students who wanted these courses had no alternative but to learn FORTRAN.

Evaluating completed programs as to content, degree of difficulty or complexity, etc., does not solve the problem of evaluating pupil progress. Grading progress in computer programming seems to be more difficult than in the usual secondary disciplines. No satisfactory solution has as yet been reached to the problem of grading progress as opposed to production; nor has a solution been reached as to what extent success in computer programming should influence grading in the elected mathematics and science courses into which computer programming has been integrated.

The lack of textual and reference material geared to the IBM 1130 forced teachers to rely largely on notes gleaned from their IBM programmed instruction course. As most of the reference materials on hand related to other machines, preparing any materials from them for use with the IBM 1130 was painstaking.

Although both principals agreed that the program exposed some students to challenging and worthwhile experiences in keeping with the growing demands of an ever increasing computerized society, and both agreed that a relief period for the key teachers was necessary, they pointed out that the addition of replacement teachers increased the problem of housing in their already overcrowded schools and compounded the problem of "floating" teachers.

RECOMMENDATIONS

The program should have a full-time coordinator with time to handle the logistics involved, to establish more communication with local universities, other school systems with similar projects, personnel in business and industry, and organizations and associations dealing with computers and their uses.

Now that the first year of experimentation is over and all have tangible knowledge to go on, consultants should be called in early to assist the coordinator in redirecting, extending, and evaluating the program.

Additional keypunch machines should be placed in the center schools, and eventually in other schools that include computer programming in the curriculum.

The computer center should be made available in evening hours and on Saturdays for students and teachers unable to use the computers immediately after school hours. It is suggested that, in addition to the computer center assistant, a teacher be on duty to assist with questions beyond the range of technical aid and possibly to teach classes of interested teachers (promising survivors of the IBM in-service courses) and students.

Provision for remuneration and relief periods should be made for teachers who become involved in the program to the extent that the seven key teachers are involved.

Provision should be made to offer a summer program in 1969 involving a greater number of students, including students at lower levels than the junior year.

Funds should be provided for visitation of the coordinator or one of the key teachers to a school system in which computer oriented programs have been in operation for several years.

It would be advisable to work toward a separate course in computer programming, or, in lieu of this, offer sections of these special mathematics and science courses which are not computer oriented, thus allowing students a choice. Another possibility is the addition of one laboratory period per week to students enrolled in these classes.

The key teachers who are now involved in this program should be involved in any revision or future planning, serving as resource personnel and/or instructors for teachers newly introduced to computers.

CONCLUSION

It is through the foresight and initiative of the Orleans Parish School Board and the Superintendent and his staff that this program came into being. The program took shape under the Division of Instruction with welcome assistance from the IBM Corporation, The Boeing Company, and the Louisiana State University in New Orleans. The staff coordinator and the seven teachers who put the program into practice in their classrooms are unanimous in their feeling that the real accolades must go to the students. Whatever success the program has achieved must be credited to their interest, enthusiasm, initiative, and performance in Problem Solving - Computer Style.

APPENDIX A

A Report on Support Provided to the New Orleans Public Schools' Exemplary Project "Problem Solving Computer Style"

April 7, 1968

Submitted by: James A. Lash J. A. Lash

F. W. Hoffman F. W. Hoffman

1.0 Introduction

The objectives of the exemplary project, "Problem Solving Computer Style", are, briefly, to enrich the educational program, provide student motivation, develop course materials, develop programming skills, and encourage broader computer use throughout the schools. In October 1967, the project was brought to the attention of the authors. Investigation revealed several areas in which professional support would benefit the project. Assistance was provided in three areas:

1. The development of a test to measure progress in learning computer fundamentals (development of test materials was a requirement of the government grant).
2. Instruction and consultation for the regular teachers participating in the project.
3. Direct student instruction in the technical areas of computer programming and internal machine operations.

Professional assistance was provided by J. Dowell, F. Hoffman, J. Kothe, J. Lash, K. Winningkoff, and E. Yeager, all of whom are employed by The Boeing Company.

2.0 Support Provided

Initial support included five orientation and working sessions with the teachers and administrative personnel. Government and IBM (the equipment vendor) support to the project, training which the teachers had received, computer usage, keypunch problems, development of a computer sciences course within the schools, and a summer program for 1968 were discussed during these sessions. We presented seminars on the topics of flowcharting and computer fundamentals. These sessions required 24.5 manhours of effort.

As a result of these sessions, it was agreed that we would develop a test which would provide a quantitative measure of student computer knowledge. The test includes forty multiple choice questions of progressively increasing difficulty in the areas of Definitions, FORTRAN, Computer Applications, Flowcharting, Programming Fundamentals, Problem Solving Techniques, and Systems' Analysis Techniques. The tests were administered both early and late in the school year, scored by us, and returned to the teachers for comparative analysis.

The majority of our effort was directed to the students participating in the project. Classes were conducted at both the Behrman and Kennedy high schools on flowcharting, fundamentals of computer operation, and computer programming

languages. In addition, the authors conducted four evening classes in assembly language programming for seven students from Kennedy High School.

We anticipate further professional participation in the exemplary project in the areas of consultation, assistance in arranging field trips, and direct student instruction.

3.0 Conclusions and Recommendations

One has only to talk with the students to see that the program has satisfied its objective of stimulating their interest. Their knowledge of computers and programming has improved noticeably during the period we have observed. We would make the following recommendations for the future:

1. Provide more training for the teachers involved in the program, particularly in the areas of computer fundamentals and monitor systems.
2. Put the computer to broader use within the instructional program. It can be used for business and administrative applications as well as for scientific work.
3. Provide a more balanced emphasis within the program. Systems' Analysis, per se, is becoming a respected and worthwile career field. Total emphasis on mathematical problems is unrealistic in light of the ratio of pure mathematicians to engineers and and programmers in the professional world.

4. Encourage the students to experiment with the computer and its programming languages. It is functionally impossible to damage the computer mechanically with a program.

In conclusion, we found the project to be an unusual and rewarding experience for both the students and ourselves and hope that we may continue to be of service.

APPENDIX B

COMPUTER PRINCIPLES EXAMINATION

COMPUTER PRINCIPLES EXAMINATION

Read each question carefully. Choose the most correct answer and place the letter on the answer sheet.

1. The Central Processing Unit (CPU) of a computer performs which of the following functions:

   a. scheduling of programs
   b. printing of listings
   c. control of computer program operation
   d. reading input cards

2. A procedure written in a computer code for solving a well defined problem is:

   a. an input deck
   b. an arithmetic function statement
   c. a flowchart
   d. a program

3. A Fortran symbol meaning "is replaced by" is:

   a. →
   b. *
   c. /
   d. =

4. If I=1, J=3, K=4, and L=2, the Fortran expression I + J*K/L**2 has a value:

   a. 13
   b. 4
   c. 37
   d. 49

5. Stored program digital computers were first used in which of the following areas:

   a. scientific
   b. business
   c. education
   d. government

6. The Fortran language was developed primarily to assist:

   a. accountants
   b. business managers
   c. teachers
   d. scientists and engineers

7. A graphical procedure for planning a computer program is:

   a. flowcharting
   b. coding
   c. debugging
   d. bar charting

8. Which of the following symbols represents a decision:

   a.

   b.

   c.

   d.

9. The sum of 101_2 and 011_2 is:

   a. 0112_2
   b. 0010_2
   c. 0111_2
   d. 1000_2

10. The principal difference between a compiler and an assembler is:

   a. no difference
   b. a compiler generates many instructions for each line of program code
   c. an assembler organizes subroutines
   d. a compiler requires no source program

11. Which of the following Fortran statements represents the Pythagorean Theorem for a right triangle with sides A,B, and C:

   a. C = (A + B)* 2
   b. C = SQRT (A**2 + B**2)
   c. C = $\sqrt{A^2 + B^2}$
   d. C = SQRT (A**2) + SQRT (B**2)

12. A computer routine to calculate the roots of polynomials would typically use which of the following approaches:

   a. calculation
   b. analysis
   c. inspection
   d. iteration

13. All of the following are examples of data storage media except:

    a. magnetic tape
    b. card reader
    c. drum
    d. disk

14. A program which is associated with the CALL statement and which returns control to a master program is a:

    a. procedure
    b. subroutine
    c. arithmetic function
    d. algorithm

15. Which of the following format statements correctly expresses READ (2,3) AB, IB, ZB:

    a. 2 FORMAT (1X, F3.5, F3.5, F3.5)
    b. 3 FORMAT (1X, E6.2, I7, F3.5)
    c. 3 FORMAT (F5.3, I7, E6.2)
    d. 2 FORMAT (E6.2, F3.5, I6.2)

16. Given I = -3, IF(3*I + 9) 10, 11, 12 will cause what statement to be executed:

    a. 10
    b. 11
    c. 12
    d. none of the above

17. Analog is to digital as:

    a. continuous is to discrete
    b. approximate is to estimated
    c. slow is to fast
    d. compiled is to wired

18. It has been suggested that one area of computer application has added significantly to the stability of the American economy. Which of the following areas would that be:

    a. payroll
    b. inventory
    c. accounting
    d. scientific data reduction

19. Graphically representing a computer program does not aid:

    a. documentation
    b. coding
    c. debugging
    d. none of the above

20. Which of the following is the primary FORTRAN tool for altering program flow:

    a. GO TO
    b. computed GO TO
    c. IF
    d. all of the above

21. An hexadecimal numbering system is based on:

    a. 6
    b. .6
    c. 16
    d. 60

22. A computer core memory is so named because:

    a. it is the center of the computer
    b. it is made of ferrite cores
    c. it is directly addressable
    d. it is essential storage

23. The FORTRAN capability that aids in matrix operations is:

    a. DO Loops
    b. subscripting
    c. self-indexing FORMAT
    d. none of the above

24. A "Library Routine" is:

    a. found in a library
    b. supplied by the computer manufacturer
    c. a standard computer program
    d. a program for computing cosine

25. Which of the following represents a system analytical approach to problem solving?

    a. the scientific method
    b. flowcharting
    c. B = PxDxKxV
    d. goal setting

26. Many problems are too complex to allow precise mathematical description. A computer technique often used is:

    a. simulation
    b. modeling
    c. list processing
    d. approximation

27. The power of a computer is inversely related to "cycle time" which, in turn, is affected by all of the following except:

    a. electrical components
    b. bit-parallel transfer rate
    c. I/O time
    d. architecture

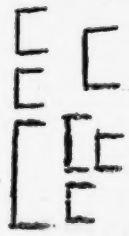
28. A program which can be executed several times simultaneously is said to be:

    a. recursive
    b. re-entrant
    c. reiterative
    d. self-restoring

29. Computer hardware used for subscripting:

    a. accumulators
    b. real-time clock
    c. index registers
    d. trigger circuit

30. Nested DO's are characterized by which of the following"

    a. internal index modification
    b. 
    c.
    d. none of the above

31. Distribution of the resources of a computer among several programs is called:

    a. multi-processing
    b. system degradation
    c. memory swapping
    d. time sharing

32. Supervisors, monitors, and executive systems were developed to:

    a. increase throughput
    b. reduce human intervention
    c. perform hardware oriented operations
    d. all of the above

33. The logical operation AND may be defined by:

    a. 1011_2 AND $1101_2 = 11100_2$
    b. 1011_2 AND $1101_2 = 01001_2$
    c. 1111_2 AND $0011_2 = 01100_2$
    d. 1011_2 AND $1101_2 = 01111_2$

34. A program which executes slowly because it must print many lines of output is said to be:

    a. I/O bound
    b. computation bound
    c. inefficient
    d. costly

35. A bit is:

    a. the smallest unit of information
    b. the sign of a number
    c. a special computer operation
    d. none of the above

36. The execution of several programs by sharing time among them is referred to as:

    a. multiprocessing
    b. multiprogramming
    c. multiaccessing
    d. serial processing

37. A multiprocessing system must have:

    a. two interconnected CPU's
    b. a time sharing monitor
    c. separate printers for each process
    d. remote terminals

38. Computer programs use all of the following to make decisions except:

    a. branch
    b. flags
    c. counters
    d. tests

39. A solution technique which produces a feasible solution by applying a pragmatic set of decision rules is said to be:

    a. algorithmic
    b. deterministic
    c. heuristic
    d. optimal

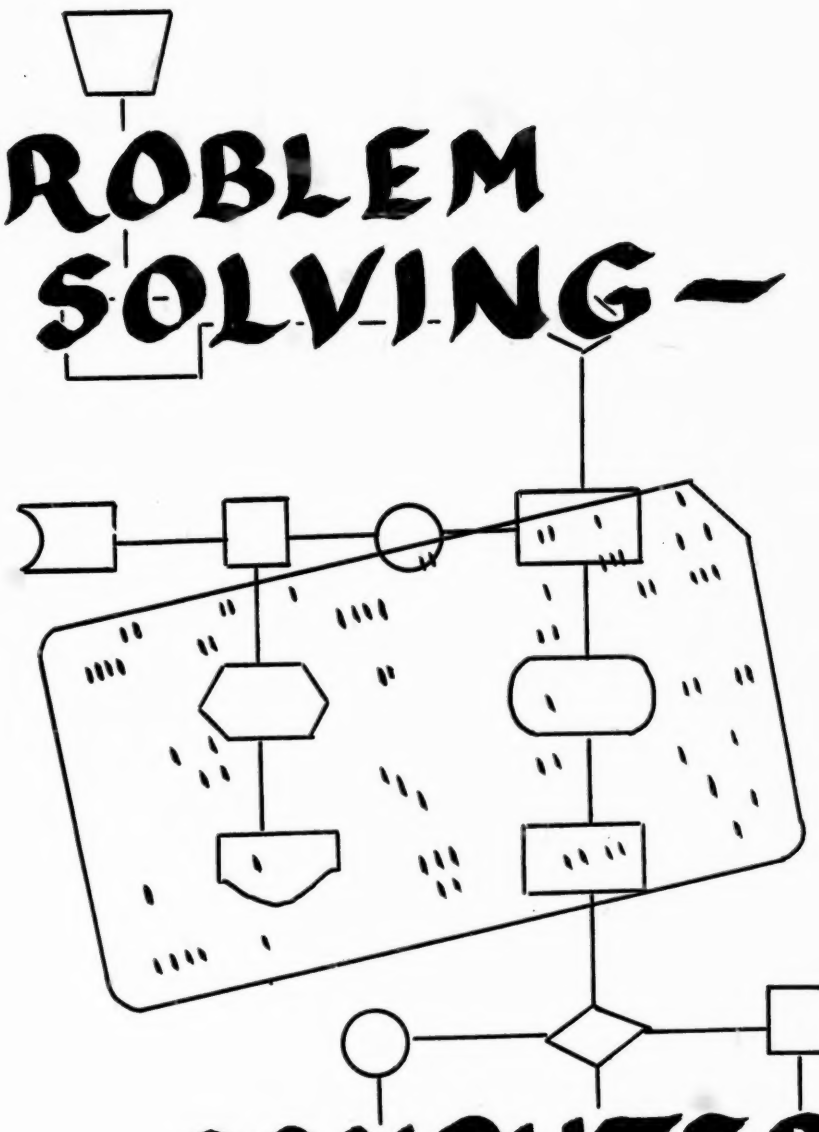
40. The boundary between computer systems is referred to as the:

    a. system limit
    b. system interface
    c. functional boundary
    d. system range

APPENDIX C

SUMMER '68 PROGRAM

PROBLEM SOLVING — COMPUTER STYLE



SUMMER '68

Summer 1968 Computer Program Calendar

(Students)

Registration (at both centers)

Friday, May 31....1:00 p.m. - 3:00 p.m.
Monday, June 3....8:00 a.m. - 12:00 m.

Notification of Selection (by telephone or letter)

Tuesday, June 4

Organization of Classes

Wednesday, June 5....8:00 a.m.

Classes

Begin....Thursday, June 6
End.....Friday, July 19

Available Computer Center Services

June 3 - July 26....8:00 a.m. - 4:45 p.m.
except Saturdays, Sundays, and holidays

PROBLEM SOLVING - COMPUTER STYLE

1968 SUMMER PROGRAM

For
Students and Teachers of Orleans Parish
in
Public and Nonpublic Schools
Funded by a Grant
Under Title III
of the
Elementary and Secondary Education Act
of
1965

Division of Instruction
New Orleans Public Schools

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- Teaching Staff
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- Credit

- Registration
  - Eligibility
  - Place
  - Dates and Times

- Selection of Student Participants

- Classes
  - Duration
  - Organization
  - Schedule

Computer Center Services 9

- Students (not enrolled in classes at the Computer Centers)
- Teachers

Summer 1968 Computer Program Calendar (inside cover)

FOREWORD

Current literature on the role of the computer in American education equates the effect on society of the rapid development of the computer and its applications to the effect of the Industrial Revolution. One application of the computer is its use as a problem solving tool.

During the 1967-68 session instruction in computer mathematics and programming was implemented into the advanced mathematics, chemistry, and physics courses offered in the twelfth year in two New Orleans public senior high schools. As the year progressed students at lower levels were given similar instruction as an extracurricular activity on a voluntary basis. Students from public and nonpublic secondary schools in New Orleans have made use of the computers to run programs or to participate in demonstrations.

This program is designed to introduce more high school students and teachers of Orleans Parish to this innovative technique of solving problems related to the mathematics and science areas of the curriculum.

Computer Centers

Location

Martin Behrman Senior High School
715 Opelousas Avenue
New Orleans, Louisiana 70114

John F. Kennedy Senior High School
5700 Wisner Boulevard
New Orleans, Louisiana 70124

Telephone

Behrman Center.....362-4192
Kennedy Center.....283-3350

Computer System

Central Processing Unit, IBM 1131
Printer, IBM 1132
Card Read/Punch, IBM 1442
Card Punch, Printing, IBM 029

Available Services

The Computer Centers will be open for use by secondary pupils and teachers of Orleans Parish 8:00 a.m. to 4:45 p.m. from June 3 through July 26 daily except Saturdays, Sundays, and holidays.

Assistants

Behrman.....To be named
Kennedy.....Mr. Charles Wick

Summer Course

for

Students of Orleans Parish

in

Public and Nonpublic Schools

Grades 10-12

Course Content

Basic computer concepts and terminology
Computer mathematics and programming techniques
FORTRAN computer language
Hands-on experiences with the computer

Teaching Staff

Behrman
Mr. Michael A. Achary
Mr. Harold J. Contreary
Mr. Milton Roos

Kennedy
Mr. Raymond P. Cougle
Miss Jean I. Cullen
Mr. Edmond C. Drouet
Mrs. Solange G.Petersen

Fees

There is no fee for the course. Materials and supplies such as data processing cards, flow charting sheets, coding sheets, etc., will be furnished free of charge.

Credit

No credit will be issued in connection with the course. Students who complete the course will receive a certificate of participation.

Registration

Eligibility

Students attending Orleans Parish public and nonpublic senior high schools, Grades 10-12, are eligible to register for the course provided that, upon registration, they present report cards as evidence that they have successfully completed Algebra II, and a note signed by the principal or counselor of their respective schools verifying that their curriculum for the session 1968-69 is mathematics-science oriented.

In addition, each applicant will be required to take a programmer aptitude test at the time of registration, and to indicate his intent to attend classes regularly and to complete the course.

Place

Behrman Center - Room 204
Kennedy Center - Room A 101

Dates and Times

Friday, May 31 - 1:00 p.m. - 3:00 p.m.
Monday, June 3 - 8:00 a.m. - 12:00 m.

Selection of Student Participants

The teaching staff at each center will serve as selection committees in their respective centers. On the basis of the data obtained from their registration forms, the results of the aptitude test, and the date and time of registration, the students will be ranked and a list established.

The first 30 applicants on the established list at the Behrman Center and the first 40 applicants on the established list at the Kennedy Center will be notified by telephone or letter of their selection.

In the event that any student selected is not able to fulfill his commitment to the program, the next person on the list will be notified of the vacancy.

Classes

Duration

Classes will be of two (2) hours duration and will be conducted in the mornings, Monday through Friday, beginning Thursday, June 6 and ending Friday, July 19.

Organization

Students who have been notified of their selection will report to the registration centers on Wednesday, June 5 at 8:00 a.m. for class organization. Three (3) classes at Behrman and four (4) classes at Kennedy, each consisting of ten (10) students, will be organized and assigned one class per teacher.

Schedule

The time schedule of classes will be so arranged as to allow each class an equal share of computer time.

Computer Center Services

for

Students

Not Enrolled in Classes at the

Computer Centers

and

Teachers

of

Orleans Parish

in

Public and Nonpublic Schools

Students (not enrolled in classes) at the Computer Centers

Students who are receiving instruction in computer mathematics and programming in secondary summer schools, other than the two computer centers, may request time on the computers and the services of the computer center assistants by telephoning the centers.

Such students should be accompanied by their instructors or, upon arrival at the centers, they should produce some form of identification attested to by their instructors.

Teachers

Teachers of secondary schools in Orleans Parish who have had some preliminary training in programming techniques, but who have not had any hands-on experience with the computer, and teachers of secondary schools who have prepared programs and wish to run them on the computer may request time on the computer and the services of the computer assistants by telephoning the centers.

APPENDIX D

COMPUTER QUESTIONNAIRE

COMPUTER QUESTIONNAIRE

RATINGS
4 - VERY GOOD
3 - SATISFACTORY
2 - POOR
1 - NO OPINION

	Rating			
PART I	4	3	2	1
To what degree do you think the computer classes have:	Percent			
1. Excited new interest in your study of mathematics	51	34	10	5
2. Helped you to organize the solutions of problems more logically	56	24	15	5
3. Helped you to understand the general concepts of science and mathematics which are being illustrated by the problems and you must solve	44	36	15	5
4. Encouraged you to work on your own for information beyond that supplied by your instructors	50	23	16	11
5. Helped you to realize the role of computers in mathematics and science	90	6	4	
6. Helped you to develop some skill in programming fundamentals	62	28	8	2
7. Stimulated you to formulate problems that can be solved on the computer	41	30	21	8
8. Helped you to feel a greater sense of participation than is ordinatily experienced in regular mathematics and science classes	50	15	26	9
9. Helped you to recognize the importance and capability of the computer in modern day living	83	11	3	3
10. Enriched the current mathematics and science programs	60	22	10	8
PART II				
Rate the following using the same ratings as in part one.				
1. Your progress	34	35	26	5
2. Your success in writing programs	48	28	18	6
3. Quality of instruction	62	19	13	6
4. Availability of computer time	61	15	21	3
5. Availability of keypunch time	31	19	50	

PART III

Answer yes or no to the following questions:	Yes	No	No Opinion
	Percent		
1. Would it be better if presented as a separate course?	92	8	
2. Should students be allowed to work at their own pace?	80	16	4
3. Should a keypunch operator be available to punch your programs?	13	87	
4. Should the history of the computer be taught?	48	45	7
5. Has the computer taken time away from regular lessons?	48	48	4
6. Do you think group discussion would be helpful and/or desirable?	81	19	
7. Do you feel that everyone has an equal opportunity to run programs?	55	45	
8. Do you feel your programs should be debugged for you?	20	80	
9. Is the computer center assistant able to assist you in your difficulties?	84	12	4
10. Do you feel that the program has been a worthwhile experience for you?	87	13	

APPENDIX E

THE PASSED-FAILED REPORT

THE PASSED-FAILED REPORT COMPUTER STYLE

This program was prepared by three senior students of John F. Kennedy Senior High School as a voluntary project to terminate instruction in computer programming which had been offered during the regular session. Students did the work on their own time; and since the data required was not available until the last week of school, these students came back to school after they were officially graduated.

The report is an annual one submitted by each school to the Division of Instruction. The raw data usually prepared by each teacher gives the percentage of students who passed and the percentage of students who failed each of the teacher's separate courses. The school then prepares a summary, first by course classification, then by departments. Finally a recapitulation of departments is made to arrive at a percentage of passed and failed courses for the entire school. This job is time consuming, and the availability of the computer at Kennedy shortened compilation time considerably. In addition to the time-saving aspect of compiling the summary, preparing this program proved to be a successful way of introducing the computer to the faculty.

The first program was designed so that the console printer gave all explanations to each teacher, who then entered data as the program directed, and copied his answers on an official form. As the teacher did this, the program provided a punched card output of the information entered, to be used as data for the main program.

When all teacher-forms were complete, two previously written programs were used to sort the data cards, and the final execution of the summary program was begun.

Graduates were in attendance to assist the teachers if necessary. In the above described manner, a task which normally involves the work of two teachers for two full working days was abbreviated to less than an hour's work on the computer to produce two copies of the final report. Since this is an annual report, the program can easily be updated to be used again in future years. The possibility also exists that revisions may be made in the program which could improve its efficiency, but these revisions will probably become assignments of students who participate in the program next year.

Solange G. Petersen
Instructor

```
// JOB
// FOR
*IOCS(CARD,DISK,1132PRINTER,TYPEWRITER,KEYBOARD)
* LIST SOURCE PROGRAM
*NAME PF
      DIMENSION X(9),NENR(9),NLEFT(9),NDROP(9),NPASS(9),NFAIL(9)
      DIMENSION NREMN(9)
   59 NSUM=0
   56 WRITE (1,15)
   15 FORMAT ('PRESS THE NPRO BUTTON ON THE CARD READER TO GET ALL THE C
     1ARDS OUT.  THEN PLACE A DECK OF'/,'BLANK CARDS IN THE HOPPER OF TH
     2E CARD READER.  AFTER THAT, PRESS PROGRAM START.'/)
      PAUSE
   88 WRITE (1,16)
   16 FORMAT ('WHEN YOU ARE ASKED TO ENTER A NUMBER BE SURE TO PUT A DEC
     1IMAL POINT IN IT.  IF YOU MAKE A MISTAKE'/,'HIT THE ERASE FIELD BU
     2TTON AND ENTER IT AGAIN.  AFTER YOU HAVE TYPED IN A NUMBER, PRESS
     3THE EOF BUTTON.'//)
      WRITE (1,19)
   19 FORMAT ('MAKE SURE THAT THE NUM LIGHT TO YOUR LEFT IS ON.  IF NOT,
     1 PRESS THE BLUE NUMERIC BUTTON.'//)
   58 WRITE (1,17)
   17 FORMAT ('ENTER YOUR SUBJECT CODE.')
      READ (6,2)X(NSUM)
      NCODE=X(NSUM)
   51 NSUM=NSUM+1
      WRITE (1,1)
    1 FORMAT ('ENTER YOUR TOTAL ENROLLMENT.')
      READ (6,2)X(NSUM)
    2 FORMAT (F5.0)
      NENR(NSUM)=X(NSUM)
      WRITE (1,3)
    3 FORMAT ('ENTER THE NUMBER THAT LEFT SCHOOL.')
      READ (6,2)X(NSUM)
      NLEFT(NSUM)=X(NSUM)
      WRITE (1,4)
    4 FORMAT ('ENTER THE NUMBER THAT DROPPED THE SUBJECT.')
      READ (6,2)X(NSUM)
      NDROP(NSUM)=X(NSUM)
      NREMN(NSUM)=NENR(NSUM)-(NLEFT(NSUM)+NDROP(NSUM))
      WRITE (1,5)NREMN(NSUM)
    5 FORMAT ('THE NUMBER REMAINING IS',I4)
      WRITE (1,6)
    6 FORMAT ('ENTER THE NUMBER PASSING.')
      READ (6,2)X(NSUM)
      NPASS(NSUM)=X(NSUM)
      NFAIL(NSUM)= NREMN(NSUM)- NPASS(NSUM)
      WRITE (1,7) NFAIL(NSUM)
    7 FORMAT ('THE NUMBER FAILING IS',I4)
      PRCTP=FLOAT(100*NPASS(NSUM))/FLOAT(NREMN(NSUM))
      PRCTP=ROUND(PRCTP,10.)
      PRCTF=100.-PRCTP
      WRITE (1,8)PRCTP,PRCTF
    8 FORMAT ('THE PERCENTAGE PASSING IS',F5.1/,'THE PERCENTAGE FAILING
     1IS',F5.1//,'MAKE SURE THAT THERE ARE BLANK CARDS IN THE CARD READE
     2R, PRESS THE START BUTTON, THEN PRESS PROGRAM START.')
```

```
      PAUSE
      WRITE (2,9)NCODE,NENR(NSUM),NLEFT(NSUM),NDROP(NSUM),NREMN(NSUM),NP
     1ASS(NSUM),NFAIL(NSUM)
    9 FORMAT (I6,6I11)
      WRITE (1,10)
   10 FORMAT ('IF YOU HAVE ANY MORE TO DO, ENTER 1.  IF NOT, ENTER 0.')
      READ (6,11)LSU
   11 FORMAT (I1)
      IF (LSU)54,53,58
   53 WRITE (1,12)
   12 FORMAT ('IF YOU WANT A GRAND TOTAL, ENTER 1.  IF NOT, ENTER 0.')
      READ (6,11)JFK
      IF (JFK)54,57,62
   62 IF (NSUM-1)54,61,55
   55 J=NSUM+1
      NENR(J)=NENR(1)
      NLEFT(J)=NLEFT(1)
      NDROP(J)=NDROP(1)
      NREMN(J)=NREMN(1)
      NPASS(J)=NPASS(1)
      NFAIL(J)=NFAIL(1)
      DO 100 ME=2,NSUM
      NENR(J)=NENR(ME)+NENR(J)
      NLEFT(J)=NLEFT(ME)+NLEFT(J)
      NDROP(J)=NDROP(ME)+NDROP(J)
      NREMN(J)=NREMN(ME)+NREMN(J)
      NPASS(J)=NPASS(ME)+NPASS(J)
      NFAIL(J)=NFAIL(ME)+NFAIL(J)
  100 CONTINUE
      PRCTP=FLOAT(100*NPASS(J))/FLOAT(NREMN(J))
      PRCTP=ROUND(PRCTP,10.)
      PRCTF=100.-PRCTP
      WRITE (1,13)NENR(J),NLEFT(J),NDROP(J),NREMN(J),NPASS(J),NFAIL(J),P
     1RCTP,PRCTF
   13 FORMAT ('TOTAL NUMBER ENROLLED',I4/,'TOTAL NUMBER THAT LEFT',I4/,'
     1TOTAL NUMBER DROPPED',I4/,'TOTAL NUMBER REMAINING',I4/,'TOTAL NUMB
     2ER PASSING',I4/,'TOTAL NUMBER FAILING',I4/,'PERCENTAGE PASSING',F6
     3.1/,'PERCENTAGE FAILING',F6.1)
   57 WRITE (1,10)
      READ (6,11)NO
      NSUM=0
      IF (NO)54,54,88
   61 WRITE (1,18)
   18 FORMAT ('OH COME NOW.  YOU CAN TOTAL THIS ONE YOURSELF.')
      GO TO 57
   54 CALL EXIT
      END

UNREFERENCED STATEMENTS
 59       56       51

FEATURES SUPPORTED
 IOCS
```

ORE REQUIREMENTS FOR PF
COMMON 0 VARIABLES 152 PROGRAM 1184

ND OF COMPILATION

```
1.
ENTER YOUR SUBJECT CODE.
101.
ENTER YOUR TOTAL ENROLLMENT.
33.
ENTER THE NUMBER THAT LEFT SCHOOL.
01.
ENTER THE NUMBER THAT DROPPED THE SUBJECT.
03.
THE NUMBER REMAINING IS  29
ENTER THE NUMBER PASSING.
26.
THE NUMBER FAILING IS  3
THE PERCENTAGE PASSING IS 89.7
THE PERCENTAGE FAILING IS 10.3

MAKE SURE THAT THERE ARE BLANK CARDS IN THE CARD READER, PRESS THE START BUTTON, THEN PRESS PROGRAM START.
IF YOU HAVE ANY MORE TO DO, ENTER 1.  IF NOT, ENTER 0.
```